nLIGHT

Operators Manual | M4 Microlaser

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SUPPORT

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ABOUT THIS MANUAL

This instruction manual contains information to help buyers and operators understand how to prepare, operate, and maintain the *n*LIGHT Photonics *M4 Microlaser*.

This manual will help you operate the laser safely and properly. Your careful attention to this manual will help avoid risks, reduce repair costs, reduce process downtime, and increase the reliability of the laser.

This manual provides guidelines for safe and reliable laser operation. In addition to following the instructions found in this manual, the laser operator should adhere to the mandatory safety regulations, professional technical rules for laser safety, and other professional guidelines for safe laser operation.

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1. LASER SAFETY

*n*LIGHT M4 Microlaser lasers are carefully designed and tested to ensure that they are safe and reliable tools when used properly. However, *n*LIGHT M4 Microlasers typically emit light at wavelengths and optical powers that can be extremely hazardous to both people and property if the proper safety guidelines are not followed. This danger can be compounded when the output wavelength of laser light is invisible to the naked eye, as is the case with the M4 Microlaser product that emits in the infrared spectrum.

1.1. Responsibility for Safety

Both the owner and the operator of the laser module are responsible for ensuring that it is assembled into a system and operated in a safe manner.

The nLIGHT M4 Microlaser is defined as a laser product. It is not suitable for direct use and is solely intended to be integrated into a laser product certified by the Purchaser. The device lacks mechanical and/or safety features that contribute to the safe and proper operation. The Purchaser acknowledges that their product must comply with the applicable regulations or standards before it can be sold to an end user.

1.2. Laser Classification

Government regulations and international standards specify that lasers must be classified according to the output power or energy and the laser wavelength. In the U.S.A. the M4 Microlaser is classified as Class IV based on 21 CFR, subchapter J, part II, section 1040-10(d). The M4 Microlaser is classified as Class 4 based on the international standard, IEC 60825-1:2007.

Throughout this manual these classifications will be referred to as Class 4.

1.3. Hazards and Safety Symbols

The following table details the safety consideration symbols used to indicate hazards based on the standard DIN EN 61 310-1.

Symbol	Explanation
	This symbol indicates an imminent danger to the lives and health of persons. Failure to follow the guidelines here can result in life-threatening injuries or death.
	This symbol indicates an imminent danger of electrical energy. Failure to follow the guidelines here can result in life-threatening injuries or death.
	This symbol is used to designate tips and other useful information. This symbol indicates a potentially hazardous situation for the operator. Disregarding these instructions can have serious adverse health effects, leading to life-threatening injuries or death.
	This symbol designates application tips and other useful information.

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	WARNING refers to a potential personal hazard. It requires a procedure that, if not correctly followed, may result in serious bodily harm or death to you and/or others. Do not proceed beyond the WARNING sign until you completely understand and meet the required conditions.
	CAUTION refers to a potential product hazard. It requires a procedure that, if not correctly followed, may result in damage or destruction to the product or components. Do not proceed beyond the CAUTION sign until you completely understand and meet the required conditions.
	IEC WARNING TRIANGLE is used to further highlight safety information related specifically to the laser output of this device. This indicates a danger of coherent electromagnetic radiation.
	Risk of Electrostatic Discharge damaging components.
	Wear laser safety glasses.
IMPORTANT: To ensure the safe use of this product, safety information is included within this section and throughout the manual at appropriate points to highlight key safety considerations. Safety information is in addition to any safety information relating to the laser beam is also highlighted with the IEC warning triangle.	

Table 1 - Hazard Symbols used in this Manual

The Equipment and Product Safety Act requires manufacturers to have operators and users observe generally accepted laser operation guidelines and standards, as well as the Occupational Safety and Accident Prevention regulations.

1.4. Safety Guidelines

High-power lasers such as M4 Microlaser are capable of producing light at power levels and wavelengths that could cause permanent eye damage if proper safety guidelines are not followed. In addition to the main beam, any reflections that create secondary beams can also be of sufficient power to cause eye damage. Some M4 Microlasers operate at a high enough power to burn skin, clothing, or other surfaces. Volatile substances can inadvertently be ignited by some laser beams.

*n*LIGHT provides the following recommendations to promote safe use of the M4 Microlaser. Operators are advised to adhere to these recommendations and employ sound laser safety practices at all times.

- Use protective eyewear when operating the laser and guard against inadvertent exposure to skin or clothing. Be sure to select eyewear that is suitable for use with the wavelengths and radiation intensity that the laser emits.
- Do not remove the lid from the laser housing. These confine internal reflections within the laser housing so that the reflections are not hazardous to operators.
- Never look directly into the laser output port.
- Set up the laser and all optical components away from eye level.

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- Provide enclosures for the laser beam whenever possible.
- Post the appropriate warning signs and placards.
- When operating the laser, limit access to the area to individuals who are trained in laser safety.
- Avoid operating the laser in a darkened environment.
- Do not use the laser in the presence of flammables, explosives, or volatile solvents such as alcohol, gasoline, or ether.

Direct ocular interception of the laser output beam can cause serious eye damage or blindness. Protective eyewear is required for operation of the M4 Microlaser to shield all Class 4 emissions.

1.5. Thermal Protection

Without proper thermal management, the M4 Microlaser can quickly reach temperatures that are dangerous to operators and pose a risk of damaging equipment. See the installation section for proper integration guidelines.

- **Thermal management is required for safe and reliable M4 Microlaser operation.**
- **See Installation section for further details about thermal management requirements.**

1.6. Shutter Compliance

The M30 Microlaser is intended to be sold to an original equipment manufacturer of electronic products. It is the responsibility of that integrator to incorporate into their product a shutter that can block all bodily access to Class 4 laser radiation without turning off the laser.

The M4 Microlaser is an OEM product and does not have optical shutters. Ensure that the laser output is aimed at the intended target prior to turning the laser system ON.

1.7. Safety Compliance with Government Requirements

The M4 Microlaser laser product does not conform to the United States Government requirements for general laser safety. In the U.S.A., it is the responsibility of the buyer to whom the product was sold (end manufacturer) to comply with all laser safety requirements prior to resale. These laser safety requirements are contained in 21 CFR, Sub-chapter J and are administered by the Center for Devices and Radiological Health (CDRH).

- www.fda.gov

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The text of this federal law is available from the U.S. Government Printing Office Bookstore located in most major cities in the U.S.A. A report detailing how the laser product complies with Federal law is required before the product is shipped. The form of this report is covered in a pamphlet titled *Guide for Preparing Initial Reports and Model Change Reports on Lasers and Products Containing Lasers*, HHS Publication FDA 86-8259. This pamphlet is available at no cost from:

- U.S. Department of Health and Human Services
- Public Health Service
- Food and Drug Administration
- Center for Devices and Radiological Health
- Division of Small Manufacturers Assistance

For jurisdictions outside of the U.S.A., it is the responsibility of the buyer of this laser device to ensure that it meets the local laser safety requirements.

1.8. Applied Standards and Regulations

The following list makes no claim for completeness or accuracy. One needs to know the respective standards for the operation and management of a Class 4 laser. For special applications, additional standards are required.

Standard	Details
IEC 60825-1	Laser safety, Classification of laser systems, Requirements and user policy
IEC 60825-1	Laser safety, Laser guards and safety measures
EN 207	Personal safety protection – laser safety
EN 208	Personal eye protection – laser adjustable glasses
2006/42/EG	Machinery directive
2006/95/EG	Low voltage directives
2004/108/EG	Electromagnetic compatibility requirements
GPSG	Equipment and product safety act
1999/44/EG	Customer sales and warranty
BGV B2 UVV	Laser Radiation
BGV A8	Safety and health signs at work
BGV A1	Principles of prevention
PSA – BV	Regulations on personal protective equipment users

Figure 1 - Applied Safety Standards

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1.9. Further Reading

For additional information on laser safety, please refer to the following publications:

- *American National Standard for the Safe Use of Lasers, Z136.1*, American National Standards Institute, 2007.
- *Performance Standard for Laser Products, FDA (FR-40), 148:32252-32265*. Department of Health, Education, and Human Service Bureau of Radiological Health, July 31, 1974.
- *Laser Safety Guide, Laser Institute of America, 9th Ed*., Orlando, Florida 1993.
- *Safety with Lasers and Other Optical Sources*, D. Sliney and M. Wolbarsht, Plenum Publishing Co., New York, 1980.
- *Safety of Laser Products, Part 1: Equipment Classification, Requirements, and User's Guide, EN60825-1, 2007*, European Committee for Electrotechnical Standardization, Central Secretariat, rue de Stassart 35, B-1050 Brussels, Belgium.

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2. OPERATING PRINCIPLE

The M4 Microlaser system contains a Laser Head and a Driver, connected through a laser head driving cable.

2.1. Laser Head

The laser head contains the optical components and temperature control elements.

2.2. Driver

The driver converts the grid power and controls the Microlaser system. The driver converts the grid power (85~264 VAC, 47~63 Hz) to DC voltage (as determined by system requirements). The driver also receives the TTL signal and RS232 communication command and converts these input signals to drive current, control temperature or any other parameters necessary for optimal operation of the laser head.

Driver Laser Head

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3. INTERFACE DEFINITION

The M4 Microlaser has the following physical interface between the Microlaser and the user's system.

3.1. Driver Interface

Fig. 1 Back panel of Microlaser driver

Fig. 2 Front panel of Microlaser driver

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3.1.1.1. Power entry socket and power switch

The power entry socket connects the grid power (single phase, 3-wires), while the switch turns the grid power on/off (Fig. 1)

3.1.1.2. Gate input BNC

The BNC has a default level of 0 V input, which prevents output of a laser beam. In order to disable the laser's output, the user can short the inner pin and the case of the BNC, or input a voltage less than 0.8 V on the inner pin vs the case. (Fig 1)

3.1.1.3. Interlock input BNC

If the BNC is not connected, it indicates an error on interface of the software and corresponding LED on the front panel. If this function is not to be used, users can shorten the inner pin and the case of the BNC to bypass it. (Fig 1)

3.1.1.4. Remote key switch input BNC

If the BNC is not connected, it will indicate an error on interface of the software and corresponding LED on front panel. If the function is not used, the user can short the inner pin and the case of the BNC to bypass it.

3.1.1.5. RS232 communication interface

The communication interface connects the laser system to the user's system with a RS232 standard cable (pin-pin configured). The communication baud rate is fixed at 9600bps (Fig 1)

3.1.1.6. Analog control interface

This interface is reserved for future function expansion (Fig 1)

3.1.1.7. Laser head driving interface

The terminal side of the laser head driving cable is connected to the laser head, thus enabling the connection to the laser (Fig 2)

3.1.1.8. Key switch

The key switch protects the driver from when the Microlaser has been suspended for a long time (Fig 2)

3.1.1.9. Emergency stop

The emergency stop can be used to stop the laser during calamities. However, the button shouldn't be used when the laser is working properly as the sudden stop might damage the laser (Fig 2)

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3.2. Laser head interface

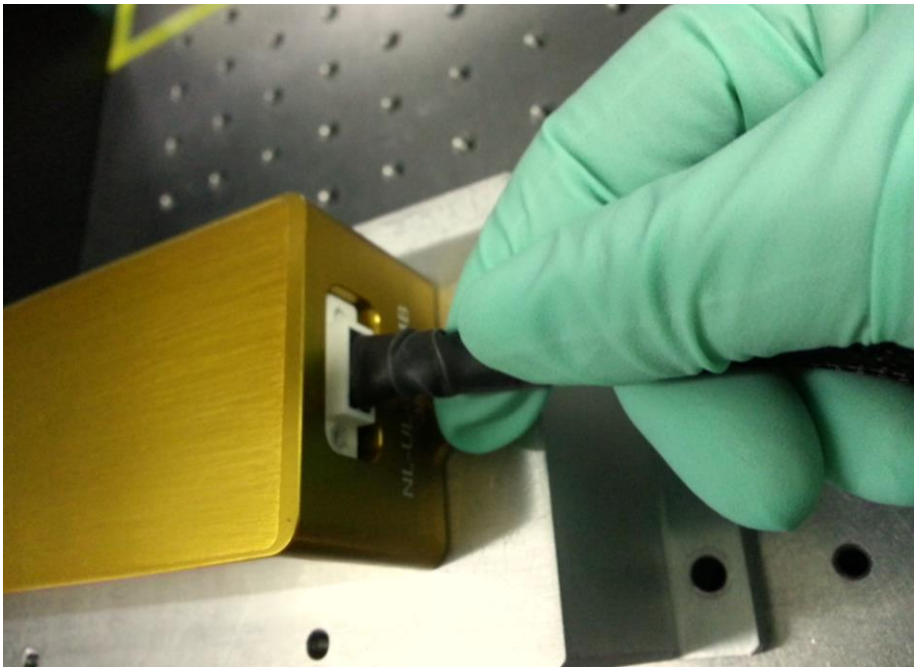

Fig. 3: Laser head interface

Only the laser head driving cable provided with the product should be used to connect to this interface. Using an incorrect cable can cause system failures or other unexpected errors (Fig 3)

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4. SOFTWARE INSTALLATION

4.1. User Computer Requirements

- Windows operating system 32-bit
- 1 GHz or faster CPU
- 1 GB RAM
- 500 MB available hard-drive space
- RS232 cable

4.2. Step by step instructions

- Insert the CD into the disk drive and open the "customer interface installer" folder.
- Double click on setup.exe.The program installs the nLight user-interface software .
- Once the installation is complete, "Start debug" folder will appear in “All Programs menu. Open the user interface from this folder (Fig 4)

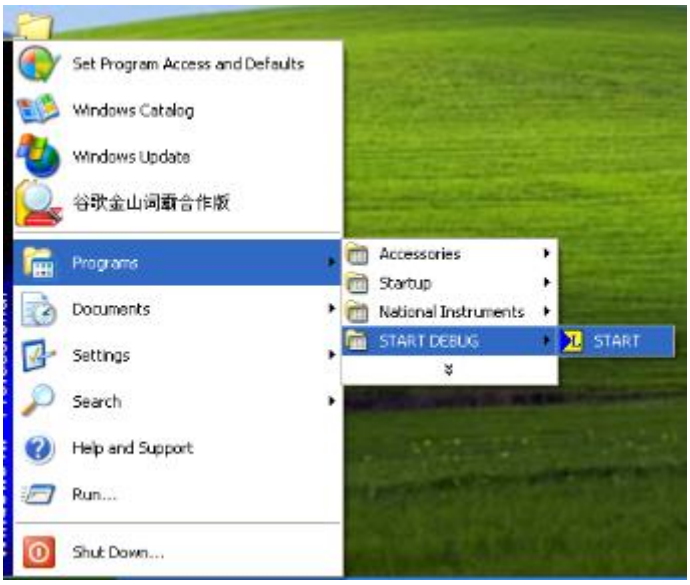
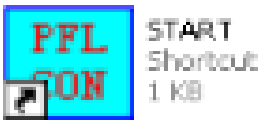


Fig. 4: Start Debug folder in Programs Menu

- For a shortcut option, the user interface can copied on to the desktop.



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5. UNPACKING, INSTALLING, UNINSTALLING AND REPACKING

5.1. Unpacking

- Place the packaging box on a stable, heavy bench while keeping the packing box with the right direction up.
- Open the box from the top using a cutter or a short knife.
- Remove the packing list, laser driver, laser head and all accessories.
- Check with the packing list, for all components to ensure nothing is missing.
- Hold on to the packaging box and shipping material for any repackaging purposes.

5.2. Installation

- Mount the laser head on a heavy, metal plate and keep the laser head in contact to a low thermal resistance plate
- Mount the laser driver on a stable plate and make sure it does not move during operation or evaluation.
- Connect the Gate input BNC cable between the system and the laser driver. Make sure the gate input signal is low.
- Connect RS232 cable between the user system and the laser driver (if necessary).
- Connect the laser head driving cable to the laser driver.
- Take out the short connector on the laser head interface and connector the laser head driving cable.
- Check the laser output exit and laser path for safety to the operator and other objects.
- Make sure the power switch is turned off, and then plug the power cable into the power entry socket.
- Connect the power cable on the wall plug.

Fig. 5: Back panel of Microlaser driver

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Fig. 6: Front panel of Microlaser driver

5.3. Uninstallation

The un-installation process is the reverse process of installation with minor differences:

- Make sure the power switch is turned off and then withdraw the power cable from the power entry socket
- Disconnect the laser head driving cable from the laser head and then mount the short connector
- Disconnect all other cables
- Move the laser driver to a stable bench if necessary

5.4. Repackaging

- If the laser system is to be moved over a long distance, the laser has to be repackaged for protection.
- Use the original packing material to repackage the laser system and keep the components in the original position in the packing box.

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6. INSTRUCTIONS FOR OPERATION

6.1. Operation mode definition

Microlaser system can be operated under different modes:

1. **RS232 mode**: Under this operating mode, the system will not output a laser power unless set by a RS232 command. Users can use nLIGHT's interface software to set the output power. Alternatively, HyperTerminal can be used to send the command using the RS232 communication protocol.
2. **Customized mode**: Under this operating mode, the system will output the laser power set to default settings. The default settings are typically set to the middle line of the power table. If the customized mode is selected, RS232 command will control the system.

The ex-work settings is determined by customer's requirements on the order. For questions on the laser's default setting, contact an nLIGHT sales agent for assistance.

6.2. Operation instruction

6.2.1. Power on:

- Install the laser according the installation instructions above
- Make sure that there's no flammable or organic material in the laser path
- Make sure the external gate signal is low
- Turn on the power switch

6.2.2. Output laser power

6.2.2.1. Output laser power: customized operation mode

- Double-check the laser path for safety
- Set the gate input signal to high, the system will then output a pre-set laser

6.2.2.2. Output a laser power: customized operation mode: RS232 mode

- Double-check the laser path for safety
- Set the gate input signal to high
- Set the driving parameters by RS232 command; the laser power specified by these parameters will then be available. (Refer to the laser evaluation chapter for more information)

NOTE: The laser is driven by both the driving current and the controlled temperature. When not necessary, do not change the default temperature settings.

6.2.2.3. Stop laser output

One of the following actions can be used to stop the output:

1. To temporarily stop the output - set the gate input signal to low (or) set the driving current to be zero (or) set the output power to zero
2. To completely stop the output, turn off the power switch

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6.3. Software Operation

6.3.1. Operation Modes

There are four operation modes that define the Microlaser system.

6.3.1.1. External control mode

Under this operation mode, the user would monitor the system. The operation mode is reserved.

6.3.1.2. RS232 control mode

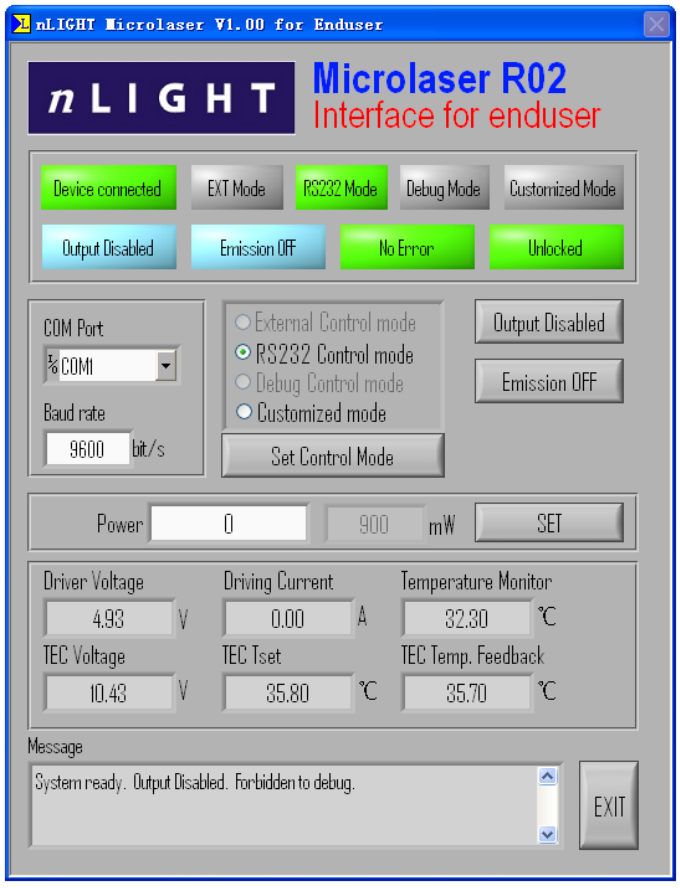
Under this operation mode, the user interface can enable status, emission status and the output power. Furthermore, the user interface can monitor the system status as defined under the external control mode.

6.3.1.3. Debug control mode

This operation mode is for nLIGHT internal use. Certain parameters and settings is saved under this control mode.

6.3.1.4. Customized mode

This operation mode can be customized to customer requirements. When powering the laser system, the laser system outputs the default laser as defined in the settings if the gating signal is active. Under this mode, the user can modify the output power by setting a new output power.



Version information

Logo information

Indicators

COM setting, operation mode setting, Enable button and emission button

Power setting and current power

Status feedback

Information

Exit button

Fig 7. Control Interface

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6.3.2.Control Interface

6.3.2.1. Version information

The version number of the software is displayed.

6.3.2.2. Logo

The nLIGHT logo and interface logo is displayed.

6.3.2.3. Indicators

There are two lines of indicator buttons (Fig 7). The first line contains 5 indicators. From L to R, they are: Laser connected indicator, External control mode indicator, RS232 control mode indicator, debug control mode indicator and customized mode indicator. The second line contains 4 indicators. From the L to R, they are: Enable status indicator, emission status indicator, error indicator and lock indicator.

6.3.2.4. Laser connected indicator

When the laser is connected, this indicator will be green in color and displays “device connected”. When the laser is not connected, it will be red and displays “device unconnected”.

6.3.2.5. External control mode indicator

If the laser is under the external control mode, this indicator will be green, otherwise it will be gray.

6.3.2.6. RS232 control mode indicator

If the laser is under the RS232 control mode, the indicator will be green, otherwise it will be gray.

6.3.2.7. Debug control mode indicator

If the laser is under the debug control mode, the indicator will be green, otherwise it will be gray.

6.3.2.8. Customized mode indicator

If the laser is under the debug control mode, the indicator will be green, otherwise it will be gray.

6.3.2.9. Enable status indicator

If the laser has no errors and is enabled, the indicator will be green and displays “Output enabled”.

6.3.2.10. Emission status indicator

If the laser is all set to emit the laser beam, the indicator is green and displays “Output enabled”.

6.3.2.11. Error indicator

If the system has any error which disables output of the laser, the indicator will be red and displays “Error!”.

6.3.2.12. Lock indicator

If the laser system has been locked, the indicator will be red and displays “interlocked”.

6.3.2.13. COM settings

The COM port can be changed- the interface automatically closes the former COM port and opens the new COM port. The baud rate cannot be changed.

6.3.2.14. Operation mode setting

Choose the operation mode and press the “Set control mode” button. This changes the settings of the operation mode.

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6.3.2.15. Enable button

This button has two display statuses. One is the OFF status, which is gray and displays “Output Disabled”. The other is ON status, which is green and displays “Output Enabled”. Press this button to change the settings.

Note: In the customized mode, this button will be hidden

6.3.2.16. Emission button

This button is used to enables/disables the laser power output. This button has two display statuses: One is the OFF status, which is gray and displays “Emission OFF”. The other is ON status, which is green and displays “Emission ON”. Press this button to change the settings.

Note: In the customized mode, this button will be hidden.

6.3.2.17. Power setting and current power feedback

There are three control options: One is the power set point input control, located at the left side. A number from 0-1000 can be typed in. Second, the middle control displays the current active set point. Finally, the third is the “SET” button on the right side. Pressing the SET” button sends a new set point to the laser.

6.3.2.18. Status feedback

This information is for the system monitor.

6.3.2.19. Information frame

This shows information about the system current status.

6.3.2.20. Exit button

This button closes the interface.

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6.3.3. Operation under Customized mode

The Microlaser system is set to default settings under the customized mode. The following procedure should be followed:

I. Check the laser status to ensure no errors or lock signals.
II. Set the expected power and press the “SET” button. Check the current power feedback to verify the setting.
III. Set the gating signal to be high. The laser will then output.

6.3.4. Operation under RS232 control mode

The Microlaser system does not have default settings under RS232 control mode. The following procedure should be followed:

I. Choose the RS232 control mode and press “Set Control Mode” button. Check the RS232 control mode indicator to verify the setting.
II. Set the expected power and press the “SET” button. Check the current power feedback to verify the setting.
III. Click the enable button and check the enable indicator to verify the enable status.
IV. Click the emission button and check the emission indicator to verify the enable status.
V. Set the gating signal to be high. The laser will then output.

Warning: If the gating signal is set to high before powering up the laser system, the laser will output immediately according to the customer’s requirements.

Warning: The Microlaser system will output laser power up to 1000mW, which can cause permanent damage on the eyes or skin, and can induce burning risks for any flammable materials.

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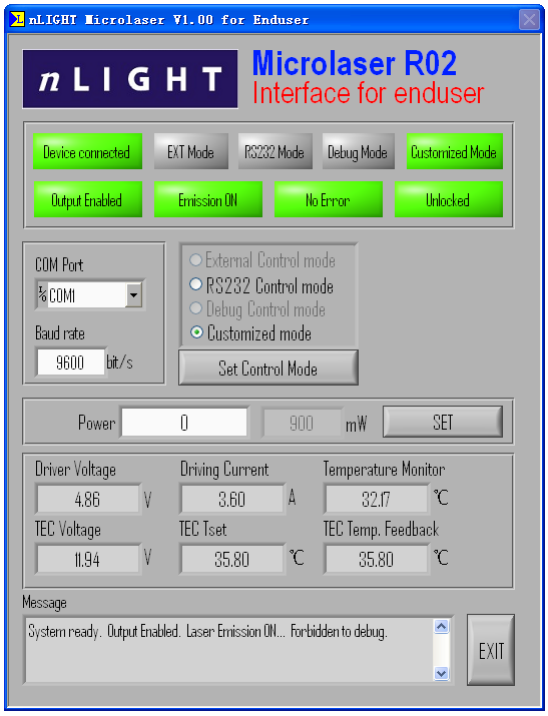

Fig. a: Customized mode interface

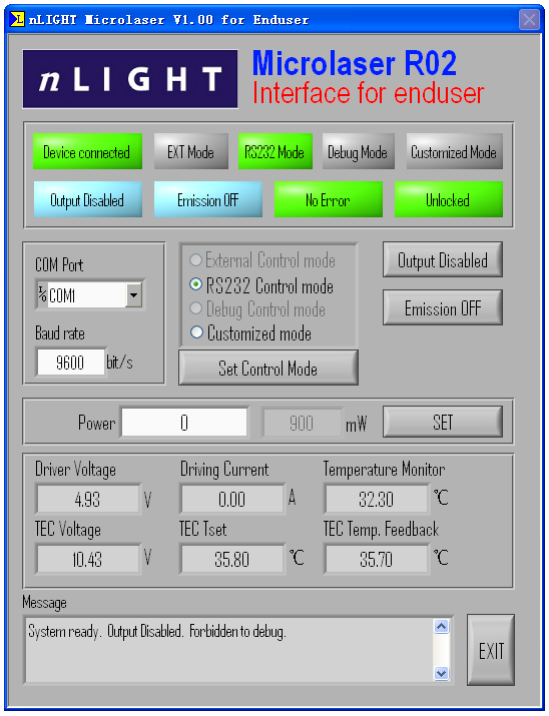

Fig. b: RS232 mode interface

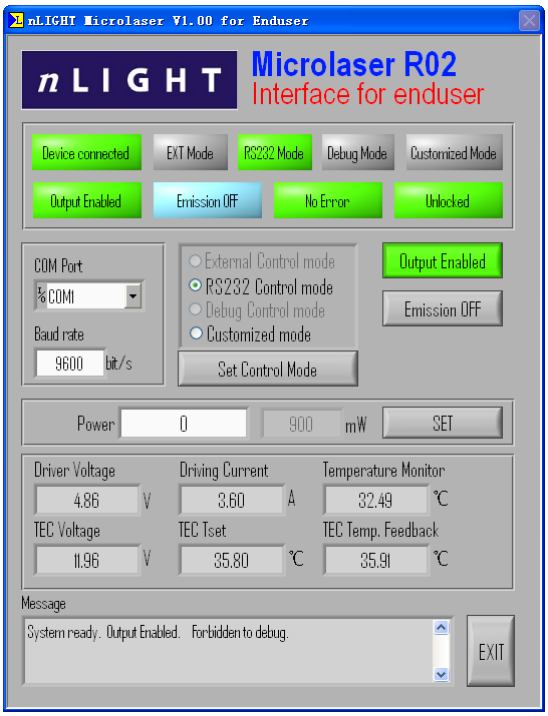

Fig. c: Enable under RS232 mode

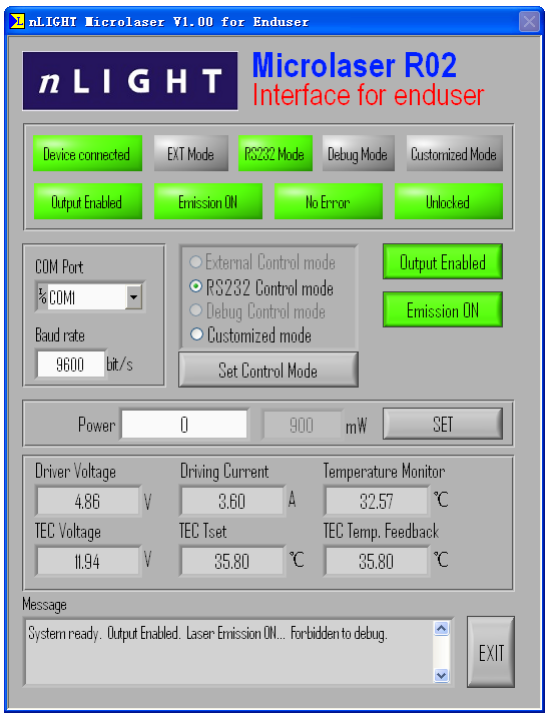

Fig. d: Emission ON under RS232 mode

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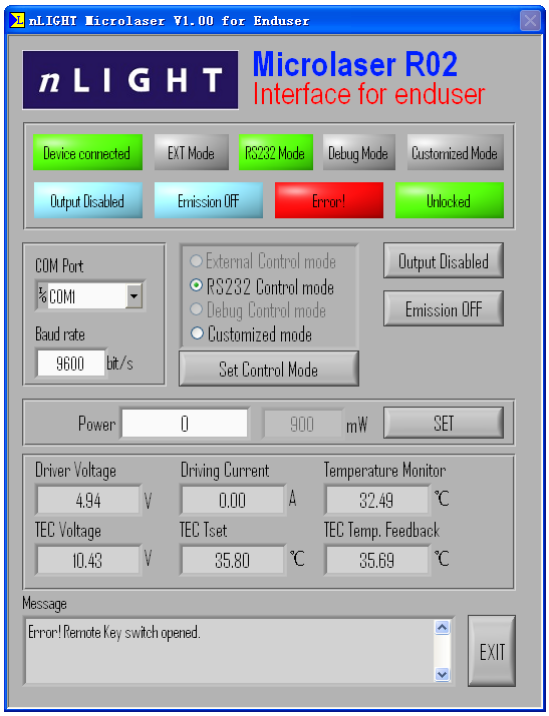

Fig. e: Error status

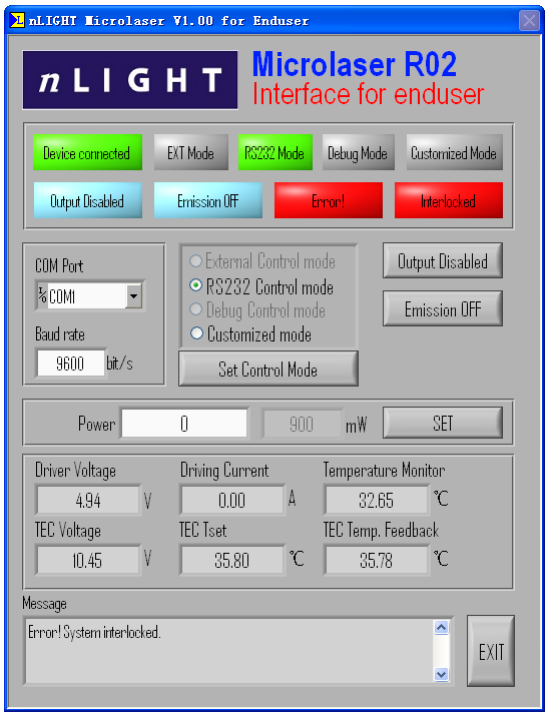

Fig. f: Interlock status

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7. LASER MAINTENANCE

Contact nLIGHT sales agent for support or performance issues.

8. TROUBLESHOOTING

Contact nLIGHT sales agent for any errors or performance issues.

9. REPAIR & RETURN (RMA) PROCESS

For any repairs, the user can return the laser system to nLIGHT. Please follow the below instructions:

1. Contact nLIGHT to obtain an RMA #
2. Repack the laser system with the original packing material
3. Mark the RMA# on the packing box
4. Ship the packing box to the specified address

nLIGHT will revert back within 10 work days after receiving the RMA device.

10. ACCESSORIES

Contact nLIGHT to obtain the RS232 communication protocol if necessary.

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